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ABSTRACT

The United States Employment Service (USES) Specific Aptitude Test Battery (SATB) for Semiconductor Occupations is evaluated from three points of view: (1) technical adequacy of the research, (2) fairness to minorities, and (3) usefulness of the battery to United States Employment Service staff and employers in selecting individuals for training in Semiconductor Occupations. Research demonstrated a statistically significant and useful relationship between proficiency in these Semiconductor Occupations and the SATB. The SATB can be expected to produce to useful increase in the proportion of highly proficient workers. When the SATB was applied to the validation sample, composed of individuals who were employed and therefore could be considered competent, an increase from 66 percent to 74 percent in the proportion of highly proficient workers was found. A greater increase can be expected when the battery is used with applicants, as the range of relevant abilities is wider among applicants than among employed workers. The report includes: (1) research summary; (2) procedure; (3) analysis; and, (4) validity of the battery. Descriptive statistics for subgroups of the validation sample; descriptive rating scale; and job description are contained in the appendices. (Author/PN)

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Development of USES Specific Aptitude Test Battery S-471R81

Semiconductor Occupations (electronics)

U.S. Department of Labor
Employment and Training Administration
U.S. Employment Service
1981

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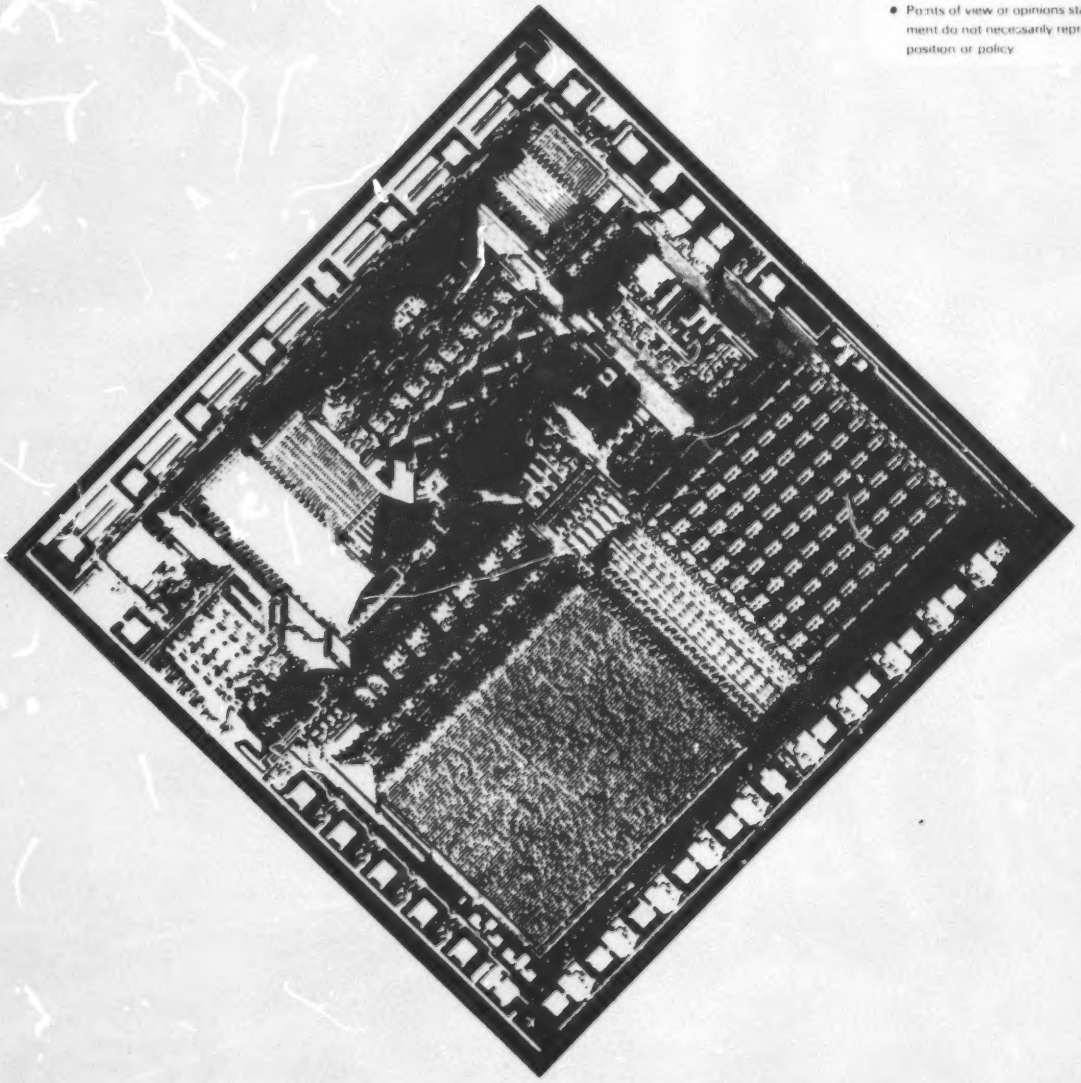

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DEVELOPMENT OF USES SPECIFIC APTITUDE TEST BATTERY

for

SEMICONDUCTOR OCCUPATIONS:

ELECTRONICS INSPECTOR (electronics) II [Semiconductor Inspector (electronics)]	726.684-022
ELECTRONICS TESTER (electronics) II	726.684-026
SEMICONDUCTOR PROCESSOR (electronics) [Chemical-Etch Operator (electronics)]	590.684-022
SEMICONDUCTOR PROCESSOR (electronics) [Photoresist Printer (electronics) I]	590.684-022

S-471R81

Analysis and Report

by

Southern Test Development Field Center
Raleigh, North Carolina

Developed in Cooperation with the
Texas State Employment Service

U.S. DEPARTMENT OF LABOR

Employment and Training Administration
United States Employment Service

1981

ACKNOWLEDGMENT

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GATB Study No. 3056

DEVELOPMENT OF USES SPECIFIC APTITUDE TEST BATTERY S-471R81

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SEMICONDUCTOR OCCUPATIONS:

ELECTRONICS INSPECTOR (electronics) II [Semiconductor Inspector (electronics)] *	726.684-022
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SEMICONDUCTOR PROCESSOR (electronics) [Chemical-Etch Operator (electronics)] *	590.684-022
SEMICONDUCTOR PROCESSOR (electronics) [Photoresist Printer (electronics) I] *	590.684-022

SUMMARY

This report is designed to provide the information required to evaluate the Specific Aptitude Test Battery (SATB) for the Semiconductor Occupations from three points of view: (1) technical adequacy of the research, (2) fairness to minorities, and (3) usefulness of the battery to Employment Service staff and employers in selecting individuals for training in Semiconductor Occupations.

Research demonstrated a statistically significant and useful relationship between proficiency in these Semiconductor Occupations and the following Specific Aptitude Test Battery:

Aptitudes	Cutting Scores
N - Numerical Aptitude	70
K - Motor Coordination	85
F - Finger Dexterity	75
M - Manual Dexterity	90

The validation sample, on which the SATB was developed, consisted of 644 employed workers in the four Semiconductor Occupations (including 321 blacks, 95 Spanish Surnamed [includes 75 Mexicans, 1 Cuban, 1 Puerto Rican, and 18 Spanish Americans], 2 American Indians, 7 Oriental, and 219 nonminorities). Data were collected during 1979. The tests used were those of the General Aptitude Test Battery (GATB) Form B-1002B; job proficiency was measured by means of ratings by the supervisors.

No evidence of differences in validity for blacks and nonminorities was found; the SATB was found to be fair to blacks and nonminorities using several definitions of fairness. Additional information may be found in the Validity of the Battery section and Appendix 1.

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*Undefined related titles as found in the Dictionary of Occupational Titles, 4th Edition

The SATB can be expected to produce a useful increase in the proportion of highly proficient workers. When the SATB was applied to the validation sample, composed of individuals who were employed and therefore could be considered competent, an increase from 66% to 74% in the proportion of highly proficient workers was found. A greater increase can be expected when the battery is used with applicants, as the range of relevant abilities is wider among applicants than among employed workers.

PROCEDURE

A concurrent design was used for the validation study; test data were collected from March through June 1979; criterion data were collected from June through November 1979.

Job Analysis

A job analysis was performed by observing the workers' performance on the job and by consulting with the workers' supervisors. On the basis of the job analysis, job descriptions were prepared which were used to select an experimental sample of workers in the four Semiconductor Occupations and choose an appropriate criterion or measure of job performance. The job descriptions shown in Appendix 4 are the result of this process and may be used to provide information on the applicability of the test battery resulting from this research. Each job duty was rated for frequency of performance, percentage of time spent, and level of difficulty as part of the job analysis. Critical job duties were identified on the basis of these ratings.

The four jobs were combined into one battery based on the following evidence:

- The job descriptions were similar
- The aptitude ratings were almost identical
- There were no significant differences between aptitude-criterion correlations
- The means and standard deviations of the aptitudes were similar.

The aptitudes were rated as irrelevant, important, or critical to the performance of the job duties. These ratings were done for each of the four jobs (Electronics Inspector II; Electronics Tester II; Semiconductor Processor [Chemical-Etch Operator] ; and Semiconductor Processor [Photoresist Printer I] and were almost identical. A synthesis of these ratings and their rationale follows:

P - Form Perception	Required to align slice with probe points and to properly adjust inker filament; to align mask under microscope to print electronic circuits on silicon slices; to align pattern on mask with pattern on slice; and to inspect slices for flaws and defects.
Q - Clerical Perception	Required to accurately read traveler (work order), meters and computer printouts; to report results of probe tests and number of slices processed to traveler; to verify stock number on mask with stock number shown on traveler; to post information

	to production control inspection sheet to indicate number and reasons for slices rejected.
K - Motor Coordination	Required to coordinate eyes and hands or fingers to adjust equipment controls and align slice with probes or mask under microscope; to coordinate eye-hand movement to move slices under microscope.
F - Finger Dexterity	Required to adjust microscope and to manipulate tweezers or fingers when picking up slices.
M - Manual Dexterity	Required to adjust equipment controls; to move controls to align slice with mask on "X" and "Y" axes; to load carriers into feed mechanism of equipment; to manipulate controls on hood and to pick up slices with vacuum pencil to place carriers into various solutions and place carrier in oven; to handle holding jigs and carriers of slices.

Experimental Test Battery

The experimental test battery for the validation sample consisted of all 12 tests of the GATB, B-1002B. Information on the composition and developmental research of the GATB may be found in the Manual for the General Aptitude Test Battery, Section III, Development, available from the Government Printing Office.

Validation Sample Description

The validation sample consisted of 644 workers in four Semiconductor Occupations (20 males and 624 females) employed at Texas Instruments Company, Dallas and Houston, Texas. A total of 425 were minority group members (321 blacks, 95 Spanish Surnamed [includes 75 Mexicans, 1 Cuban, 1 Puerto Rican, and 18 Spanish Americans], 2 American Indians, and 7 Oriental) and 219 were nonminority group members. The means and standard deviations for age, education, and experience of sample members are shown in Table 1. No sample members were test selected. All workers had a total of at least three months of experience in their current job which has duties similar to those found in the job descriptions in Appendix 4. Descriptive statistics for black, Spanish Surnamed and nonminority subgroups are shown in Appendix 1.

Criteria for Validation Study

The criteria for the validation sample consisted of supervisory ratings. The ratings were obtained by means of personal visits of test development analysts who explained the rating procedure to the supervisors. Each worker was rated twice by a first line supervisor using a standard descriptive rating scale with an interval of at least two weeks between the ratings. Each worker was also rated once by a first line supervisor using a mixed standard rating scale. Since sample members' test scores are confidential, supervisors had no knowledge of the test scores of the workers. The standard descriptive rating scale (Appendix 2) consists of six items. Five of these items cover different aspects of job performance. The sixth item is a global item on the workers' "all-around" ability. Each item has five alternative responses corresponding to different

degrees of job proficiency. For the purpose of scoring the items, weights of 1 to 5 were assigned to the responses. The total score on the rating scale is the sum of the weights for the six items. The possible range for each rating is 6-30.

A review of the job descriptions indicated that the subjects covered by the rating scale were directly related to important aspects of job performance:

A - Quantity of work: Workers in the Semiconductor Occupations must be able to maintain an acceptable production pace.

B - Quality of work: Workers in the Semiconductor Occupations must be able to maintain a high quality of work in order to avoid waste and rework time.

C - Accuracy of work: Workers in the Semiconductor Occupations should be able to adjust equipment with accuracy.

D - Job knowledge: Workers in the Semiconductor Occupations must have a knowledge of the procedures and be able to use the equipment and materials involved in processing silicon slices used in the electronics products.

E - Job versatility: Workers in the Semiconductor Occupations should be able to perform the variety of tasks included in the job.

F - "All-around" job ability: Work in the Semiconductor Occupations involves a combination of all aspects of job performance stated above which are valued by the employer.

The mixed standard rating scale consisted of ten triads covering different aspects of job performance. A triad consists of three statements describing three levels of job performance on a specific aspect of the job. A rater describes the ratee as performing better than, equal to, or worse than each statement. A triad has a score range of 1 to 7 points. The total rating score is the sum of the triad scores. The possible range for each rating is 7-70.

A review of the job descriptions indicated that the subjects covered by the mixed standard rating scale were directly related to important aspects of job performance:

Triad 1 - Quantity of work: Workers in the Semiconductor Occupations must be able to maintain an acceptable pace.

Triad 2 - Keeping written records: Workers in the Semiconductor Occupations should know what production records are required and how to keep an accurate count.

Triad 3 - Finger dexterity: Workers in the Semiconductor Occupations must possess finger dexterity to be able to manipulate small objects and hand tools.

Triad 4 - Manual dexterity: Workers in the Semiconductor Occupations must possess manual dexterity to be able to manipulate equipment and work materials.

Triad 5 - Problem solving: Workers in the Semiconductor Occupations should be able to resolve operational problems with a minimum of supervision.

Triad 6 - Alignment skills: Workers in the Semiconductor Occupations must be able to position slices correctly on equipment.

Triad 7 - Job knowledge: Workers in the Semiconductor Occupations should be able to understand written instructions and specifications.

Triad 8 - Detecting defects: Workers in the Semiconductor Occupations should be able to detect defects in materials and workmanship in order to reduce waste and rework time.

Triad 9 - Damages: Workers in the Semiconductor Occupations should be able to perform the job without damaging materials.

Triad 10 - Accuracy: Workers in the Semiconductor Occupations should be able to adjust equipment with accuracy.

A reliability coefficient of .83 was obtained between the mixed standard rating and the first descriptive rating. Because complete data were available on all 644 sample members for the descriptive rating scale but for only 428 sample members for the mixed standard scale, the descriptive rating scale was used as the final criterion. A reliability coefficient of .84 was obtained between the initial standard descriptive ratings and the reratings, indicating a significant relationship. Therefore, the final criterion score consists of the combined scores of the two standard descriptive ratings. The possible range for the final criterion is 12-60. The actual range is 13-60. The mean is 44.5 with a standard deviation of 8.6.

TABLE 1

Means, Standard Deviations (SD) and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education, and Experience

	Mean	SD	r
Age (years)	32.8	10.1	.02
Education (years)	11.9	1.4	-.06
Total Experience (months)	38.1	34.9	.13**

**Significant at the .01 level

For the purpose of the analysis, the criterion distribution was dichotomized so as to include, as nearly as possible, one-third in the low criterion group and two-thirds in the high criterion group. This is the standard procedure for SATB studies. The criterion cutting score was set at 42, which placed 34% in the low criterion group and 66% in the high criterion group.

ANALYSIS

The initial step in the analysis is to identify those aptitudes which show some evidence of validity and job relatedness. This evidence can be:

1. Statistical significance of the correlation (r) between the test and the criterion,

2. Content validity as evidenced by a rating of "critical" based on the job analysis, or

3. Any combination of the following:

   - high mean

   - low standard deviation (SD)

   - rating of "important" based on the job analysis

   - demonstrated validity in a prior validation study

Statistical results for the validation sample are shown in Table 2.

TABLE 2

Statistical Results for Validation Sample
N=644

Aptitude	Mean	SD	r
G - General Learning Ability	83.2	14.6	.22**
V - Verbal Aptitude	87.6	12.0	.14**
N - Numerical Aptitude	83.2	16.6	.23**
S - Spatial Aptitude	90.4	16.6	.15**
P - Form Perception	102.5	18.7	.17**
Q - Clerical Perception	105.8	14.2	.16**
K - Motor Coordination	106.1	15.0	.07
F - Finger Dexterity	99.3	20.6	.15**
M - Manual Dexterity	105.0	19.7	.10**

**Significant at the .01 level

Table 3 summarizes the qualitative analysis and statistical results shown in Table 2 and shows the aptitudes considered for inclusion in the battery.

TABLE 3

Summary of Qualitative and Quantitative Data for Validation Sample

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Ratings									
Critical									
Important					X	X	X	X	X
Irrelevant									
Statistical Evidence									
High Mean						X	X		X
Low SD	X	X				X	X		
Significant r	X	X	X	X	X	X		X	X
Aptitudes Considered for Inclusion in the Battery	G	V	N	S	P	Q	K	F	M

The information in Table 3 indicates that the following aptitudes should be considered for inclusion in the battery: G, V, N, S, P, Q, K, F and M. The objective is to develop a battery of 2, 3, or 4 aptitudes with cutting scores at the point (a) where about the same percent will meet the cutting scores as the percent placed in the high criterion group and (b) which will maximize the relationship between the battery and the criterion. The cutting scores are set at approximately one standard deviation below the mean aptitude scores of the sample, with deviations at five point intervals above or below these points to achieve the objectives indicated above.

The following battery resulted:

Aptitudes	Cutting Scores
N - Numerical Aptitude	70
K - Motor Coordination	85
F - Finger Dexterity	75
M - Manual Dexterity	90

VALIDITY OF THE BATTERY

This section of the report first presents evidence of criterion-related validity of the SATB on the validation sample and all relevant subsamples. Next, it provides information on effectiveness and fairness of test norms.

Criterion Related Validity

Table 4 shows that there is a significant relationship between the job performance criterion and the SATB for the validation sample in aggregate and for the black and nonminority subgroups. The validity coefficient for the Spanish Surnamed subgroup is not statistically significant at the .05 level; however, since the difference between the phi coefficients for the Spanish Surnamed and nonminority subgroups is not statistically significant, differential validity is not shown.

TABLE 4

Validity of Battery

Sample	N	High Criterion Group		Low Criterion Group		Chi Square χ^2	Significance Level p/2<	Phi Coefficient ϕ
		Below Cutting Scores	Meeting Cutting Scores	Below Cutting Scores	Meeting Cutting Scores			
Total	644	152	270	129	93	28.9	.0005	.21
Black	321	76	113	81	51	13.9	.0005	.21
Nonminority	219	51	105	35	28	9.8	.005	.21
Spanish Surnamed	95	23	47	13	12	2.1	.10*	.15

*Yates' corrected

Table 5 shows that there is a significant relationship between the job performance criterion and the SATB for each of the four Semiconductor Occupations.

TABLE 5

Validity of Battery

Sample	N	High Criterion Group		Low Criterion Group		Chi Square χ^2	Significance Level p/2<	Phi Coefficient ϕ
		Below Cutting Scores	Meeting Cutting Scores	Below Cutting Scores	Meeting Cutting Scores			
Semiconductor Processor[1]	223	55	100	41	27	11.9	.0005	.23
Semiconductor Processor[2]	90	29	43	12	6	3.0	.05*	.18
Electronics Inspector II[3]	127	28	47	29	23	4.2	.025	.18
Electronics Tester II	204	40	80	47	37	10.3	.005	.23

*Yates' corrected

[1]Photoresist Printer I
[2]Chemical-Etch Operator
[3]Semiconductor Inspector

Multiple regression analysis was conducted between aptitudes N, K, F, and M and the criterion. A multiple correlation of .26 (significant at the .01 level) was obtained between the job performance criterion and aptitudes N, K, F, and M.

Effectiveness of the Battery

The level of validity shown in Table 4 indicates that the battery will be useful in selection. In the total validation sample, 66% were considered to be highly proficient. Of those who met the cutting scores, 74% were highly proficient, an increase of 8 percentage points over the existing selection method. These findings are shown in Table 6.

TABLE 6

Effectiveness of the Battery

Selection System	Number Selected	Highly Proficient (High Criterion Group)		Marginal (Low Criterion Group)	
		N	%	N	%
Validation Sample					
Without Tests	644	422	66	222	34
With Tests	363	270	74	93	26

This research sample consisted of employed workers on whom some selection had already taken place; presumably those workers who lacked the required abilities had quit, been fired, or had been transferred. Therefore, a greater increase over existing selection methods in the proportion of highly proficient workers selected is to be expected when the battery is used for selection, as the range of relevant abilities is almost certainly greater among applicants than among employed workers.

Subgroup Analysis

No differential validity for this battery was found. The differences between the phi coefficients for minority and nonminority groups are not statistically significant (black - nonminority, CR = -.04; Spanish Surnamed - nonminority, CR = -.52).

The battery is fair to blacks, Spanish Surnamed, and nonminorities since the proportion of each who met the cutting scores approximated the proportion who were in the high criterion group; 51% of the blacks met the cutting scores and 59% were in the high criterion group; 62% of the Spanish Surnamed met the cutting scores and 74% were in the high criterion group; 61% of the nonminorities met the cutting scores and 71% were in the high criterion group.

APPENDIX I

Descriptive Statistics for Black, Spanish Surnamed, and Nonminority Subgroups of Validation Sample

	BLACK (N=321)			SPANISH SURNAMED (N=95)			NONMINORITY (N=219)		
Variable	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Aptitude G	77.2	10.7	45-110	80.8	12.8	49-118	93.1	14.9	54-154
Aptitude V	83.1	8.2	65-115	85.5	10.9	66-119	95.3	13.1	63-131
Aptitude N	77.6	14.2	38-113	81.7	16.5	36-119	91.7	16.3	48-155
Aptitude S	85.3	14.5	58-133	89.2	14.3	58-130	98.3	17.2	68-153
Aptitude P	98.9	18.4	37-149	102.1	16.3	65-147	107.8	19.1	65-160
Aptitude Q	103.2	13.3	69-153	103.7	13.1	67-136	110.8	14.6	72-151
Aptitude K	107.0	14.5	68-148	106.6	13.9	76-142	104.0	15.6	56-144
Aptitude F	100.0	20.2	44-161	101.8	16.9	65-143	96.9	22.6	41-163
Aptitude M	106.5	20.2	52-189	107.7	14.1	73-137	101.3	20.4	43-153
Criterion	43.0	8.3	13-60	46.8	8.5	23-60	45.7	8.8	21-60
Age	32.1	8.1	18-61	30.0	7.3	19-56	34.9	12.8	18-65
Education	12.3	1.0	9-17	10.7	1.8	6-17	11.8	1.3	7-17
Total Experience (months)	40.2	33.5	3-180	35.2	26.4	3-115	36.0	39.8	3-247

APPENDIX 2

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DESCRIPTIVE RATING SCALE

SCORE _____

RATING SCALE FOR _____

D.O.T. Title and Code

Directions: Please read the "Suggestions to Raters" and then fill in the items which follow. In making your ratings, only one box should be checked for each question.

SUGGESTIONS TO RATERS

We are asking you to rate the job performance of the people who work for you. These ratings will serve as a "yardstick" against which we can compare the test scores in this study. The ratings must give a true picture of each worker or this study will have very little value. You should try to give the most accurate ratings possible for each worker.

These ratings are strictly confidential and won't affect your workers in any way. Neither the ratings nor test scores of any workers will be shown to anybody in your company. We are interested only in "testing the tests." Ratings are needed only for those workers who are in the test study.

Workers who have not completed their training period, or who have not been on the job or under your supervision long enough for you to know how well they can perform this work should not be rated. Please inform the test technician about this if you are asked to rate any such workers.

Complete the last question only if the worker is no longer on the job.

In making ratings, don't let general impressions or some outstanding trait affect your judgment. Try to forget your personal feelings about the worker. Rate only on the work performed. Here are some more points which might help you:

1. Please read all directions and the rating scale thoroughly before rating.

2. For each question compare your workers with "workers-in-general" in this job. That is, compare your workers with other workers on this job that you have known. This is very important in small plants where there are only a few workers. We want the ratings to be based on the same standard in all the plants.

3. A suggested method is to rate all workers on one question at a time. The questions ask about different abilities of the workers. A worker may be good in one ability and poor in another: for example, a very slow worker may be accurate. So rate all workers on the first question, then rate all workers on the second question, and so on.

4. Practice and experience usually improve a worker's skill. However, one worker with six months' experience may be a better worker than another with six years' experience. Don't rate one worker as poorer than another merely because of a lesser amount of experience.

5. Rate the workers according to the work they have done over a period of several weeks or months. Don't rate just on the basis of one "good" day, or one "bad" day or some single incident. Think in terms of each worker's usual or typical performance.

6. Rate only the abilities listed on the rating sheet. Do not let factors such as cooperativeness, ability to get along with others, promptness and honesty influence your ratings. Although these aspects of a worker are important, they are of no value for this study as a "yardstick" against which to compare aptitude test scores.

NAME OF WORKER (Print) (Last) (First)

SEX: MALE_____ FEMALE_____

Company Job Title: _____

How often do you see this worker in a work situation?

- ☐ All the time.
- ☐ Several times a day.
- ☐ Several times a week.
- ☐ Seldom.

How long have you worked with this worker?

- ☐ Under one month.
- ☐ One to two months.
- ☐ Three to five months.
- ☐ Six months or more.

A. How much can this worker get done? (Worker's ability to make efficient use of time and to work at high speed.) (If it is possible to rate only the quantity of work which a person can do on this job as adequate or inadequate, use #2 to indicate "inadequate" and #4 to indicate "adequate.")

- ☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.
- ☐ 2. Capable of low work output. Can perform at a slow pace.
- ☐ 3. Capable of fair work output. Can perform at an acceptable pace.
- ☐ 4. Capable of high work output. Can perform at a fast pace.
- ☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good is the quality of work? (Worker's ability to do high-grade work which meets quality standards.)

- ☐ 1. Performance is inferior and almost never meets minimum quality standards.
- ☐ 2. Performance is usually acceptable but somewhat inferior in quality.
- ☐ 3. Performance is acceptable but usually not superior in quality.
- ☐ 4. Performance is usually superior in quality.
- ☐ 5. Performance is almost always of the highest quality.

C. How accurate is the work? (Worker's ability to avoid making mistakes.)

- ☐ 1. Makes very many mistakes. Work needs constant checking.
- ☐ 2. Makes frequent mistakes. Work needs more checking than is desirable.
- ☐ 3. Makes mistakes occasionally. Work needs only normal checking.
- ☐ 4. Makes few mistakes. Work seldom needs checking.
- ☐ 5. Rarely makes a mistake. Work almost never needs checking.

D. How much does the worker know about the job? (Worker's understanding of the principles, equipment, materials and methods that have to do directly or indirectly with the work.)

- ☐ 1. Has very limited knowledge. Does not know enough to do the job adequately.
- ☐ 2. Has little knowledge. Knows enough to get by.
- ☐ 3. Has moderate amount of knowledge. Knows enough to do fair work.
- ☐ 4. Has broad knowledge. Knows enough to do good work.
- ☐ 5. Has complete knowledge. Knows the job thoroughly.

E. How large a variety of job duties can the worker perform efficiently? (Worker's ability to handle several different operations.)

- ☐ 1. Cannot perform different operations adequately.
- ☐ 2. Can perform a limited number of different operations efficiently.
- ☐ 3. Can perform several different operations with reasonable efficiency.
- ☐ 4. Can perform many different operations efficiently.
- ☐ 5. Can perform an unusually large variety of different operations efficiently.

F. Considering all the factors already rated, and only these factors, how good is this worker? (Worker's all-around ability to do the job.)

- ☐ 1. Performance usually not acceptable.
- ☐ 2. Performance somewhat inferior.
- ☐ 3. A fairly proficient worker.
- ☐ 4. Performance usually superior.
- ☐ 5. An unusually competent worker.

Complete the following ONLY if the worker is no longer on the job.

G. What do you think is the reason this person left the job? (It is not necessary to show the official reason if you feel that there is another reason, as this form will not be shown to anybody in the company.)

- ☐ 1. Fired because of inability to do the job.
- ☐ 2. Quit, and I feel that it was because of difficulty doing the job.
- ☐ 3. Fired or laid off for reasons other than ability to do the job (i.e., absenteeism, reduction in force).
- ☐ 4. Quit, and I feel the reason for quitting was not related to ability to do the job.
- ☐ 5. Quit or was promoted or reassigned because the worker had learned the job well and wanted to advance.

RATED BY	TITLE	DATE
COMPANY OR ORGANIZATION	LOCATION (City, State, ZIP Code)	

GPO 863-716

MA 7-66
Apr. 1973

APPENDIX 3

MIXED STANDARD RATING

INFORMATION TO BE PROVIDED BY RATER

RATINGS FOR _____, TEXAS INSTRUMENTS
(Company Job Title)

RATED BY _____ TITLE _____

LOCATION _____ Texas _____ DATE _____
(City) (State) (Zip Code)

Which ethnic group best describes you? Check (✓) one.

_____ 1. Caucasian _____ 3. Oriental

_____ 2. Black _____ 4. American Indian

Which minority group best describes you? Check (✓) the one most applicable, if any.

_____ 1. Cuban _____ 6. Eskimo _____ 11. Korean

_____ 2. Mexican _____ 7. French Canadian _____ 12. Polynesian

_____ 3. Puerto Rican _____ 8. Japanese _____ 13. Indonesian

_____ 4. Spanish _____ 9. Chinese _____ 14. Hawaiian

_____ 5. Aleut _____ 10. Filipino

How much experience have you had in your present job with this company?

_____ Years _____ Months

How much total experience do you have in this job? Include time with both your present and previous employers, but count only time spent on this particular job.

_____ Years _____ Months

Directions: Please read the "Suggestions to Raters" and then fill in the items which follow. In making your ratings, only one box should be checked for each question.

SUGGESTIONS TO RATERS

We are asking you to rate the job performance of the people who work for you. These ratings will serve as a "yardstick" against which we can compare the test scores in this study. The ratings must give a true picture of each worker or this study will have very little value. You should try to give the most accurate ratings possible for each worker.

These ratings are strictly confidential and won't affect your workers in any way. Neither the ratings nor test scores of any workers will be shown to anybody in your company. We are interested only in "testing the tests." Ratings are needed only for those workers who are in the test study.

Workers who have not completed their training period, or who have not been on the job or under your supervision long enough for you to know how well they can perform this work should not be rated. Please inform the test technician about this if you are asked to rate any such workers.

Complete the last question only if the worker is no longer on the job.

In making ratings, don't let general impressions or some outstanding trait affect your judgment. Try to forget your personal feelings about the worker. Rate only on the work performed. Here are some more points which might help you:

1. Please read all directions and the rating scale thoroughly before rating.

2. For each question compare your workers with "workers-in-general" in this job. That is, compare your workers with other workers on this job that you have known. This is very important in small plants where there are only a few workers. We want the ratings to be based on the same standard in all the plants.

3. A suggested method is to rate all workers on one question at a time. The questions ask about different abilities of the workers. A worker may be good in one ability and poor in another: for example, a very slow worker may be accurate. So rate all workers on the first question, then rate all workers on the second question, and so on.

4. Practice and experience usually improve a worker's skill. However, one worker with six months' experience may be a better worker than another with six years' experience. Don't rate one worker as poorer than another merely because of a lesser amount of experience.

5. Rate the workers according to the work they have done over a period of several weeks or months. Don't rate just on the basis of one "good" day, or one "bad" day or some single incident. Think in terms of each worker's usual or typical performance.

6. Rate only the abilities listed on the rating sheet. Do not let factors such as cooperativeness, ability to get along with others, promptness and honesty influence your ratings. Although these aspects of a worker are important, they are of no value for this study as a "yardstick" against which to compare aptitude test scores.

This booklet contains statements about the people whom you supervise. We would like you to compare each of your workers to each statement. Take a moment to think about each person: The quality of his/her work; his/her strong and weak points. Indicate if the worker is "about the same" as the statement, "better than" the statement or "worse than" the statement by placing a check (✓) under the appropriate response.

For instance, if you are rating John Jones and a statement reads "Does arithmetic well," and John Jones is outstandingly quick and accurate in arithmetic, you would rate him as being "better than" the statement. If, on the other hand, John makes an unacceptable number of mistakes in arithmetic, you would rate him as being "worse than" the statement. Please try to respond to every statement. However, if you feel that you are unable to respond accurately, please check "not enough knowledge to rate." For example, if you have never observed John doing arithmetic or seen arithmetic done by John you would be unable to judge his ability in arithmetic and should respond "not enough knowledge to rate." We would rather have this response than an inaccurate rating.

Mixed Standard Rating Scale

1. Is a faster worker by production standards.
2. Makes a normal number of mistakes in maintaining written records.
3. Ability to manipulate small objects such as silicon slices with tweezers and finger cots is somewhat below average.
4. Is a slower worker by production standards.
5. Operates equipment such as microscopes, timers, multi-probes, and dryers at an average pace.
6. Works well on own. Rarely needs help in resolving operational problems.
7. Ability to manipulate small objects such as silicon slices with tweezers and finger cots is average.
8. Rarely makes errors in aligning the X and Y axes.
9. Frequently needs help to resolve minor operational problems.
10. Operates equipment such as microscopes, timers, multi-probes, and dryers with somewhat faster than average speed.
11. Frequently requires assistance in understanding written instructions and specifications.
12. Catches almost all defects.
13. Makes somewhat more than the normal number of errors in aligning the X and Y axes.
14. Rarely requires assistance to understand written instructions and specifications.
15. Usually meets production.
16. Makes a few more mistakes than the average person in maintaining written records.
17. Misses many defects.
18. Rarely damages materials during the production process.
19. Makes a normal number of errors in aligning the X and Y axes.
20. Occasionally requires assistance in understanding written instructions and specifications.

21. Adjusts equipment, such as microscopes and probes with average accuracy and precision.

22. Ability to manipulate small objects such as silicon slices with tweezers and finger cots is somewhat above average.

23. Operates equipment such as microscopes, timers, multi-probes, and dryers somewhat slowly.

24. Damages materials during the production process somewhat more frequently than the average worker.

25. Makes few mistakes in maintaining written records.

26. Adjusts equipment such as microscopes and probes with somewhat less than average accuracy and precision.

27. Occasionally damages materials during the production process.

28. Misses an average number of defects.

29. Handles most operational situations properly; needs no more help than others.

30. Adjusts equipment, such as microscopes and probes with somewhat better than average accuracy and precision.

APPENDIX 4

JOB DUTIES

ELECTRONICS INSPECTOR (electronics) II [Semiconductor Inspector (electronics)] *	726.684-022
ELECTRONICS TESTER (electronics) II	726.684-026
SEMICONDUCTOR PROCESSOR (electronics) [Chemical-Etch Operator (electronics)] *	590.684-022
SEMICONDUCTOR PROCESSOR (electronics) [Photoresist Printer (electronics) I] *	590.684-022

Workers in the Semiconductor Occupations perform one of the four jobs listed in Appendix 4. However, most workers are cross-trained in one or more of the four jobs because of similarity of job tasks.

*Undefined related titles as found in the Dictionary of Occupational Titles, 4th Edition, are provided for the Electronics Inspector (electronics) II and the Semiconductor Processor (electronics) occupations as an aid in determining the applicability of the test battery resulting from this research.

JOB DUTIES S-471R81

Job Title

ELECTRONICS INSPECTOR (electronics) II 726.684-022
[Semiconductor Inspector (electronics)]

Guide for Occupational Exploration (G.O.E.) Code 06.03.02
Inspecting, Grading, Sorting, Weighing, and Recording

Job Summary

Inspects processed silicon slices to determine conformance to specifications, using microscope and inspection jig.

Work Performed

Reads work order to determine number of slices to be processed, type of pattern, and other product specifications.

*Places silicon slice on jig under microscope. Observes slice through microscope to detect existence of defects, such as undercut, incomplete etch, pinholes, and misalignment.

Removes inspected slice from microscope and sorts the slice into "accept" or "reject" trays.

Posts information to inspection sheet to record number of acceptable slices and number of reject slices.

---

*These job duties were designated as critical job duties since they must be performed competently if the job is to be performed in a satisfactory manner.

JOB DUTIES S-471R81

Job Title

ELECTRONICS TESTER (electronics) II 726.684-026

Guide for Occupational Exploration (G.O.E.) Code 06.03.02
Inspecting, Grading, Sorting, Weighing, and Recording

Job Summary

Tests conductivity of printed silicon slices, using variety of testing equipment.

Work Performed

Reads work order to determine type of probe to be performed, such as clear, ink, or photo probe.

Slides assembly, with probes, into head of equipment to load testing equipment with specified test module.

Picks up slice and places slice on chuck under microscope to position slice for probe testing.

*Moves lever to align slice on an "x" (right or left) "y" (forward or reverse) axis. Turns knob to adjust Theta alignment (fine adjustment by rotation of slice).

Pushes switch to raise or lower chuck so slice will make contact with probes and inker.

*Observes probe points to determine alignment with bonding pads on chips.

Pushes switch to start testing equipment. Inspects equipment at intervals to verify it is functioning correctly.

Removes slice, at end of testing, and visually inspects to determine if ink dots are consistent, plug bars and P.C.B. inked out, and if inked bar pattern meets specification. Places slice under microscope. Inspects probe marks to determine if they are missing, placement, scrubbing, planarization, probe mark size, and punch through and if ink is on good bars. Places slice in carrier.

Reads meters next to test machine to obtain results of test. Obtains readout or printout of test results.

Posts results to work order to show yield of test.

---

*These job duties were designated as critical job duties since they must be performed competently if the job is to be performed in a satisfactory manner.

JOB DUTIES S-471R81

Job Title

SEMICONDUCTOR PROCESSOR (electronics) 590.684-022
[Chemical-Etch Operator (electronics)]

Guide for Occupational Exploration (G.O.E.) Code 06.04.19
Equipment Operation, Assorted Materials Processing

Job Summary

Performs a variety of tasks to etch circuitry patterns on silicon slices used in various electronic products.

Work Performed

Reads work order to determine number of slices to be processed, bake time, and etch time.

Places tray of slices in oven and sets bake time according to specifications. Removes tray of slices from oven when baking process is completed.

Places sample slices in rack to be processed for test etch.

Places racks of silicon slices, following sequence and processing specifications, into acid, water, alcohol solution, and hot air dryer to etch, neutralize, and diffuse chemicals onto surface of slices.

*Inspects etched slices under microscope to determine conformance to etching specifications. Processes balance of slices through chemicals. Regulates time of etch to adjust for errors on test etch.

Inspects slices after process is completed on a random basis or inspects all slices in batch.

Posts information to work order to record number of slices processed.

---

*These job duties were designated as critical job duties since they must be performed competently if the job is to be performed in a satisfactory manner.

JOB DUTIES S-471R81

Job Title

SEMICONDUCTOR PROCESSOR (electronics) 590.684-022
[Photoresist Printer (electronics) I]

Guide for Occupational Exploration (G.O.E.) Code 06.04.19
Equipment Operation, Assorted Materials Processing

Job Summary

Prints circuits on silicon slices using photoresist printing equipment and binocular microscope.

Work Performed

Reads work order to determine stock number of pattern mask needed to process materials, number of slices to be processed, and time of exposure.

*Selects the proper pattern mask by comparing the stock number on the mask with the mask number on the work order to verify correctness.

Cleans mask using air hose. Positions mask on holding device of equipment and adjusts microscope to focus.

Places tray of slices into feed mechanism of equipment. Pushes switch to actuate equipment.

*Observes slice and mask through microscope and moves controls to rotate and align slice with mask on an "x" (right and left) "y" (forward or backward) axis and to adjust Theta alignment (fine adjustment by rotation of slice).

Pushes expose switches to actuate vacuum chuck and energize arc light and expose slice to pattern of mask.

Transfers processed silicon slices from magazine to a carrier when process is completed.

Posts information to work order to record number of slices aligned and exposed, date, shift, operator's number, and number of masks used.

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*These job duties were designated as critical job duties since they must be performed competently if the job is to be performed in a satisfactory manner.

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